Fire Fighting Decision Aids

(Delivering Critical Information for Firefighting Whenever and Wherever it is Needed)

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May 22, 2002

Part of the NIST Advanced Fire Service Technologies Research Program

Fire fighter Protective Clothing Model and Properties
Structural Collapse Prediction Technology
Evaluation of Thermal Imaging Technology
Fire Fighter Decision Aids
Community Scale Fire Spread
Response to Terrorism: WTC Fire Simulation
Response to Terrorism: Firefighter Protective Clothing (CBR)

Decision Aids Are All About Information Transfer

The more information that is available to incident command in an readily understood form, the safer and more effective operations will be.

Modern buildings contain a vast amount of relevant emergency information.

Let's get it out of there and to the responders!

Challenges
Research and Fire Service

How to interface with existing/developing systems (mobile computing, GIS)

How to include additional information in Fire Department standard operating procedures

Provide existing information – already available at panel

Display information on many kinds of hardware

Enhance existing information stream

Challenges
Research and Fire Service

Enhance existing information stream

Assess the quality and limitations of the alarm system data
Build suitable fire models to quantify the fire event
Provide condition forecasts
Provide decisions aids for action:

- **capture knowledge of fire fighting experts**
- **develop greater understanding of fire fighting dynamics**

Enable wireless emergency information transfer out of all buildings, including residential

Presentation

Vision

Background

Identified information needs

Premise

Information display

Demonstrations (w & w/o fire)

- **video**

Conclusions

Presentation and video available from authors

Background

Fire alarm systems in large buildings in the USA incorporate a display for the fire service:

Location of alarms, device type, sequence

"… to enable responding personnel to identify the location of a fire quickly and accurately and to indicate the status of emergency equipment or fire safety functions that might affect the safety of occupants …"

Located in fire command center or near likely point of entry by the responding fire service.

First responders should not have to go to a burning building to get critical information?

Critical Information

(IAFC helped to organize fire service focus groups)

What do you want to know?

When do you want to know it?

Where do you want to know it?

How should the information be presented?

Fire Service Information Needs

- **At Dispatch**
  - Confidence in alarm, size and growth rate of the fire
- **On Arrival**
  - Location of the fire, the occupants, current conditions
  - How to get to the fire
  - Staging areas, standpipes, other resource or safety issues

- **During the Incident**
  - Fire spread and growth, area(s) involved
  - Systems status, i.e., ventilation
  - Location of fire fighters
  - Controls for communications and ventilation

How To Interpret These Responses

- **Industry Perspective**
  - Consortium
    Siemens/Cerberus, Tyco/Simplex, Honeywell/Notifier, SPX/EST, NEMA, NIST
  - Develop a Model of Sensors - Current Detectors, then ...
  - Conduct Field Demonstrations and Testing

- **NIST Perspective**
  - Reliability of the signal (is it a fire?)
    Multimode and dispersed sensors
  - How big is the fire (if it is, how soon …)
    Flashover, backdraft, limits of protective clothing
  - Panel display – information wherever it is needed
    NFPA 72 Task Group
  - Tactical decision aid
    Impact of ventilation, what happens?

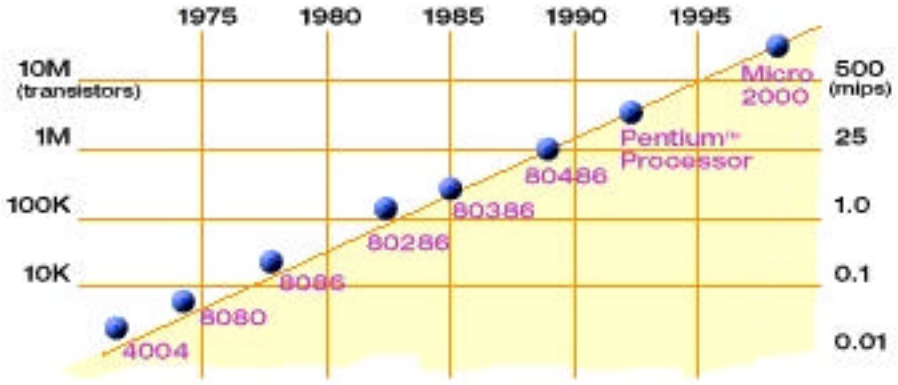
Premise!

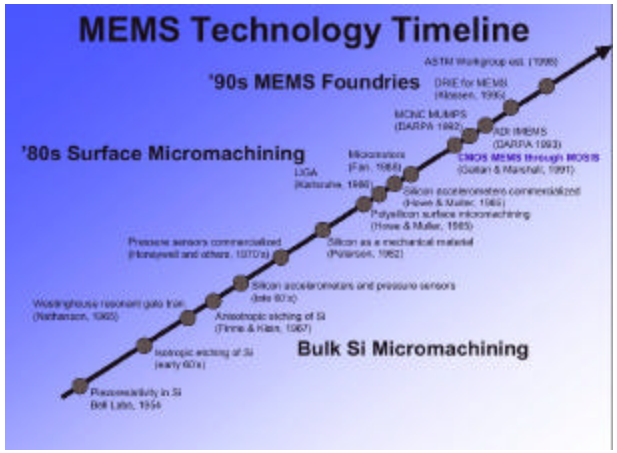
- **Electronic sensors for measurement, control, and protection in buildings will become common over the next decade.**
- **Tremendous improvements can be made in utilizing the data that will be available**
- **Fire service is ready to make use of more information in their operations**

Enabling Technology

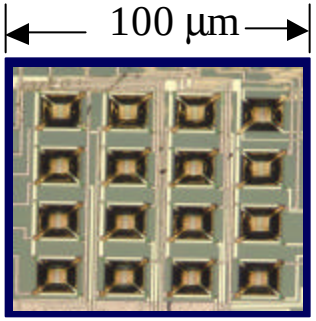
(Cheap and pervasive sensing and computing)

Moore's Law





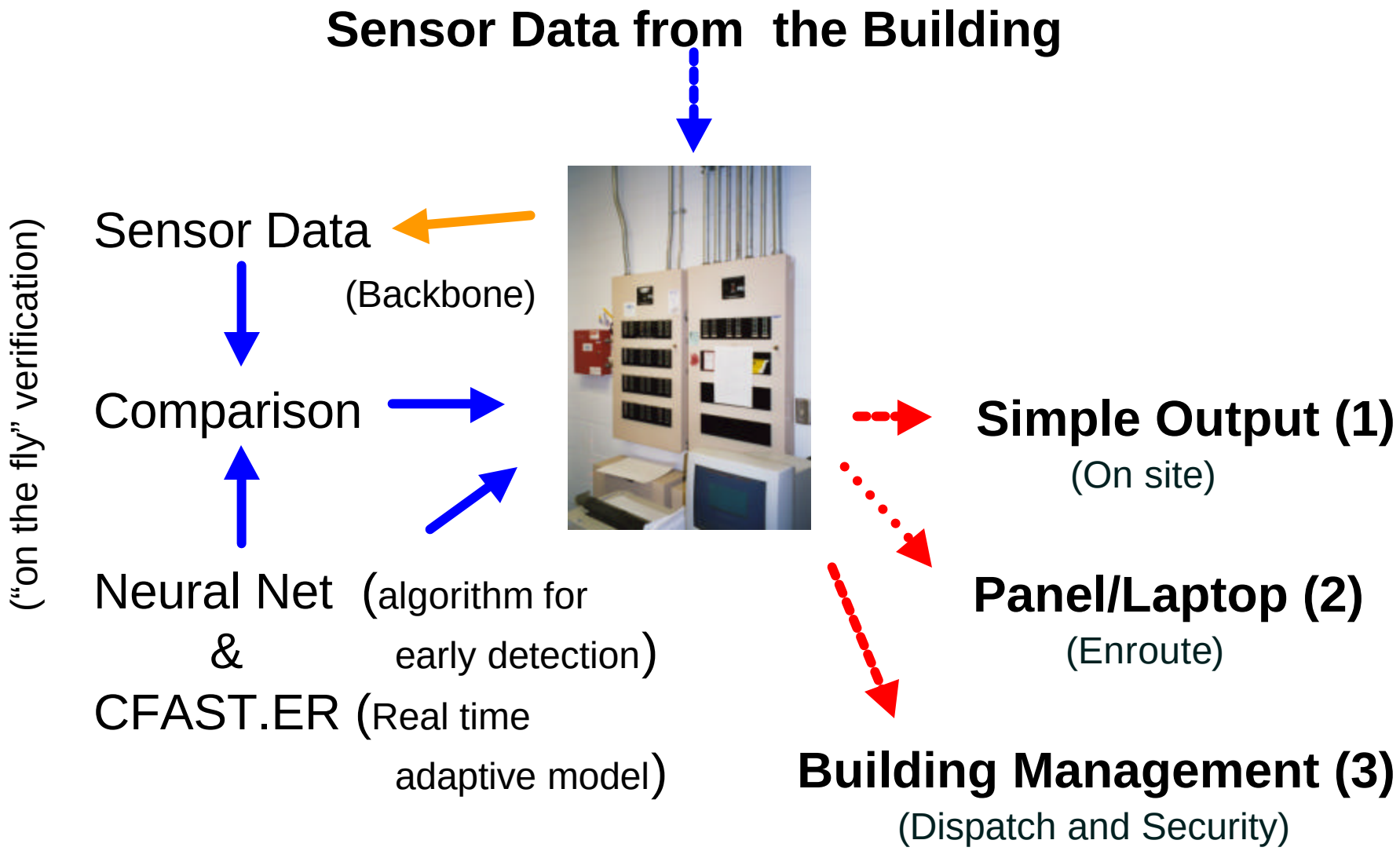
MEMS (and other) transducers



Microchemical Arrays

Detection and Alarm

- Low level sensing (early warning)
- High level sensing (fire following)
- Extract threat – heat, smoke, CO …
- Confirmation through
  - Multiple sensors
  - Feature extraction and modeling
- Display
  - High resolution, Laptop, wireless, beeper


Sensor Data from the Building
Sensor Data
(Backbone)
Comparison
Neural Net (algorithm for early detection)
&
CFAST.ER (Real time adaptive model)
("on the fly" verification)
Simple Output (1)
(On site)
Panel/Laptop (2)
(Enroute)
Building Management (3)
(Dispatch and Security)

Delivery of Information – Examples

Layer

- **Building Management**
  Building security, fire station, …

3

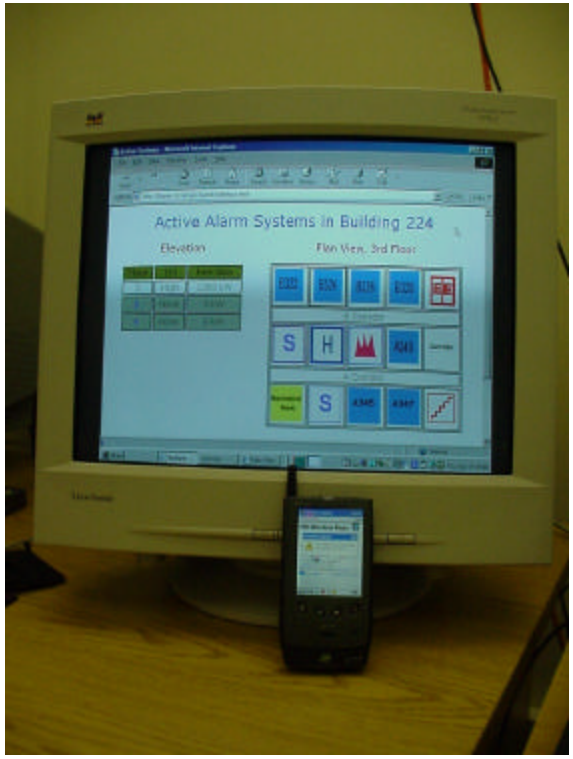
- **Panel/Laptop**
  Laptop “in vehicles”
  Building enunciator panel

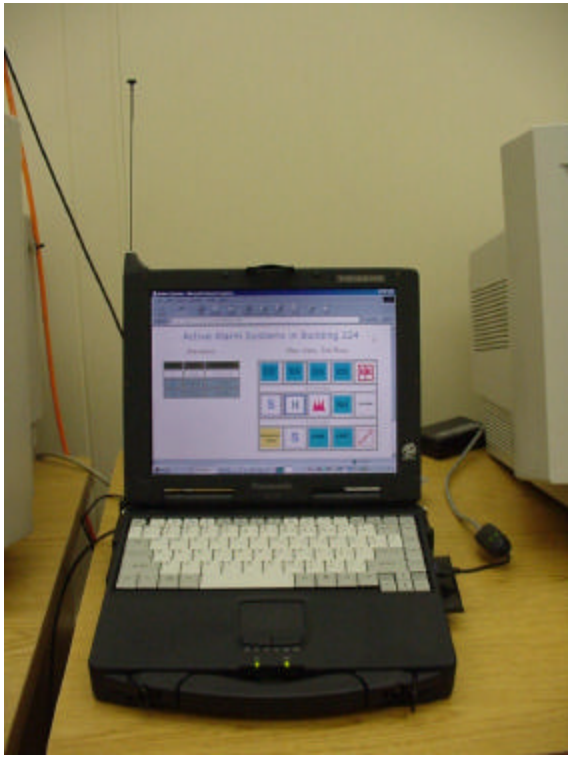
2

- **Simple Display**
  Handheld device

1

Examples of Display Technologies





72 Task Group

Scalable, Stylus, Icons, Inclusive, Intuitive

Working groups on

- Icons (Usability, Color, Scaling)
- Control functions
- Information and presentation
- For code cycle 2002, first as an appendix to NFPA 72

Prototype Icons

Alarm		Stairwell (all ratings)		Occupant	
Emergency Connection		Fire Department Key Box		Sprinkler	
Exhaust Fan		Fire Pump		Smoke Vent	
Exhaust Outlet		Fire Department Connection		Shutoff (W, E, G)	
Siamese Connection		Extinguishing System (i.e.CO_2 and Halon)		Water Mist Sprinkler	
High Pressure Gas		Egress in Progress		Electrical Room	
Manual Pull Station		Emergency Phone		Fire Service Access Point	
Smoke Detector		Fire		Elevator Equipment Room	
Standpipe		Gas Detector		Heat Detector	

27 proposed at the moment - Usability issues remain

Prototype symbology for the various components of the building system

			
Smoke Detector	Heat Detector	Fire	Sprinkler

27 proposed at the moment - Usability issues remain

Control Functions

- Emergency voice communications
  - Zone, group, all call
- Query sensors (incl. those not in alarm)
- Manual ventilation control (stairways)
- Elevators? (status of recall only?)

Accomplishments

- **NFAC Task Group: 2002 Code 72 Chapter 4**
- **Additional fire service input**
  - Questionnaire through NFPA/fire service section
  - IAFC Workshop August 2000
- **Demonstrated Information Deployment**
- **Full Scale Demonstrations**
  - NIST campus (224 {AUBE'01}, 205)

Full Scale Demonstrations

- **Important part of the project is "buy-in" from the fire service – does it work in the real world**

  Do through full scale demonstrations, press briefings, fire service involvement

- **2nd held at NIST – April, 2002**

  CPSC, Toxicity, Fire Service Demo

- **Next will be in New Castle County, Delaware**

  Performed as part of a fire evacuation drill at the County Facility

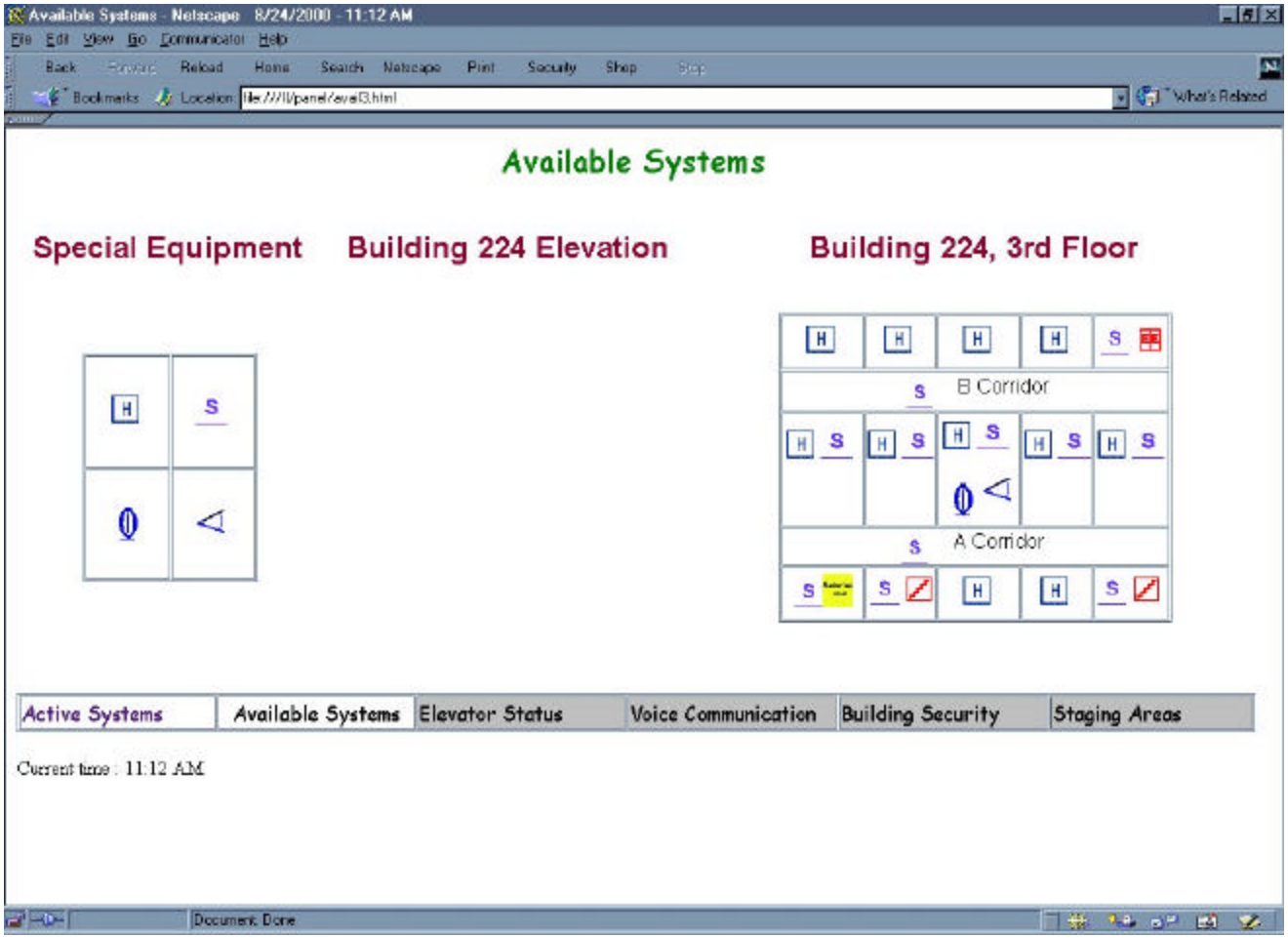
- **Prototype for a traveling show**

The Layout in Building 224

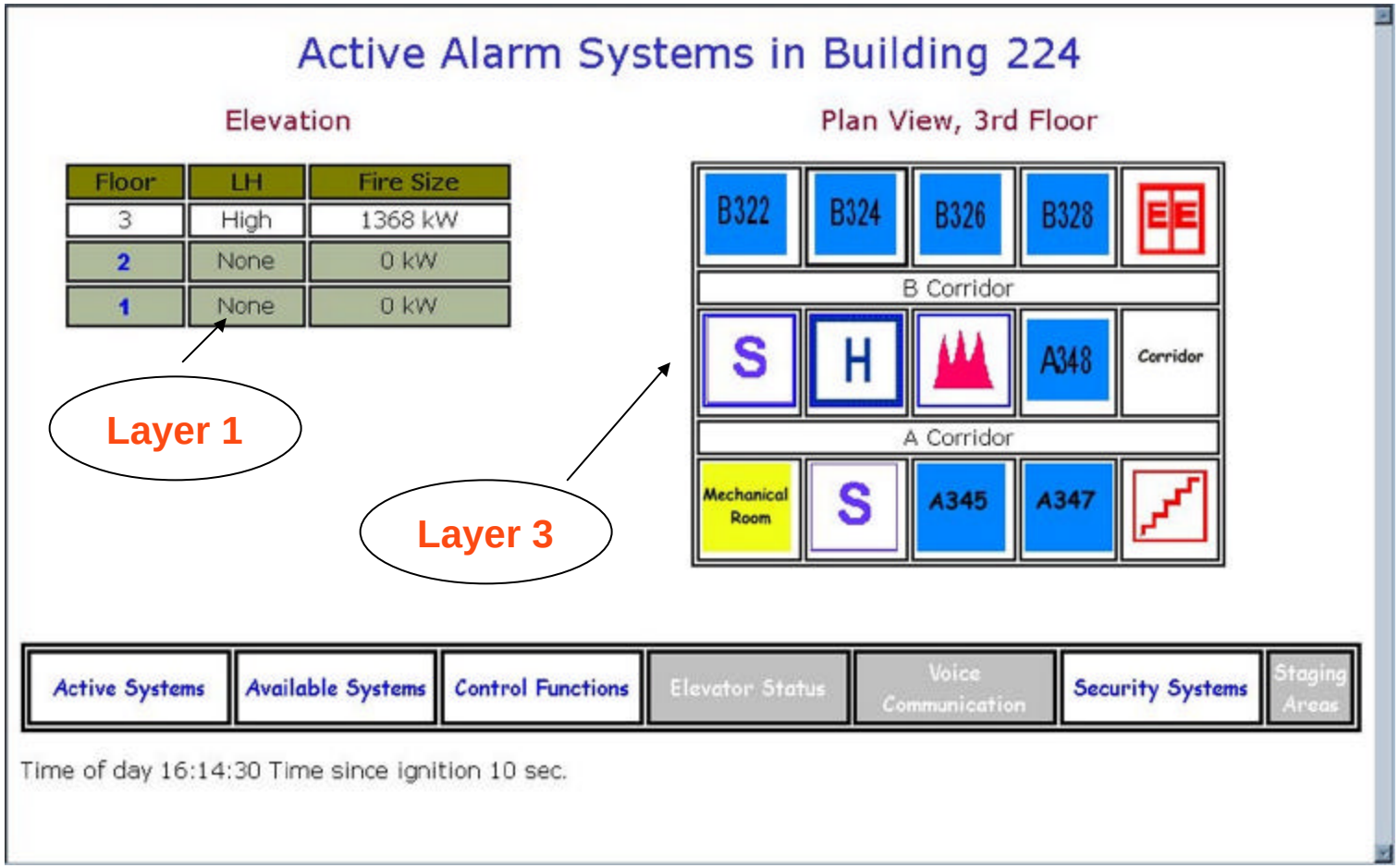
Outside	Corridor	Experiment

August, 2000

Example of Available Systems

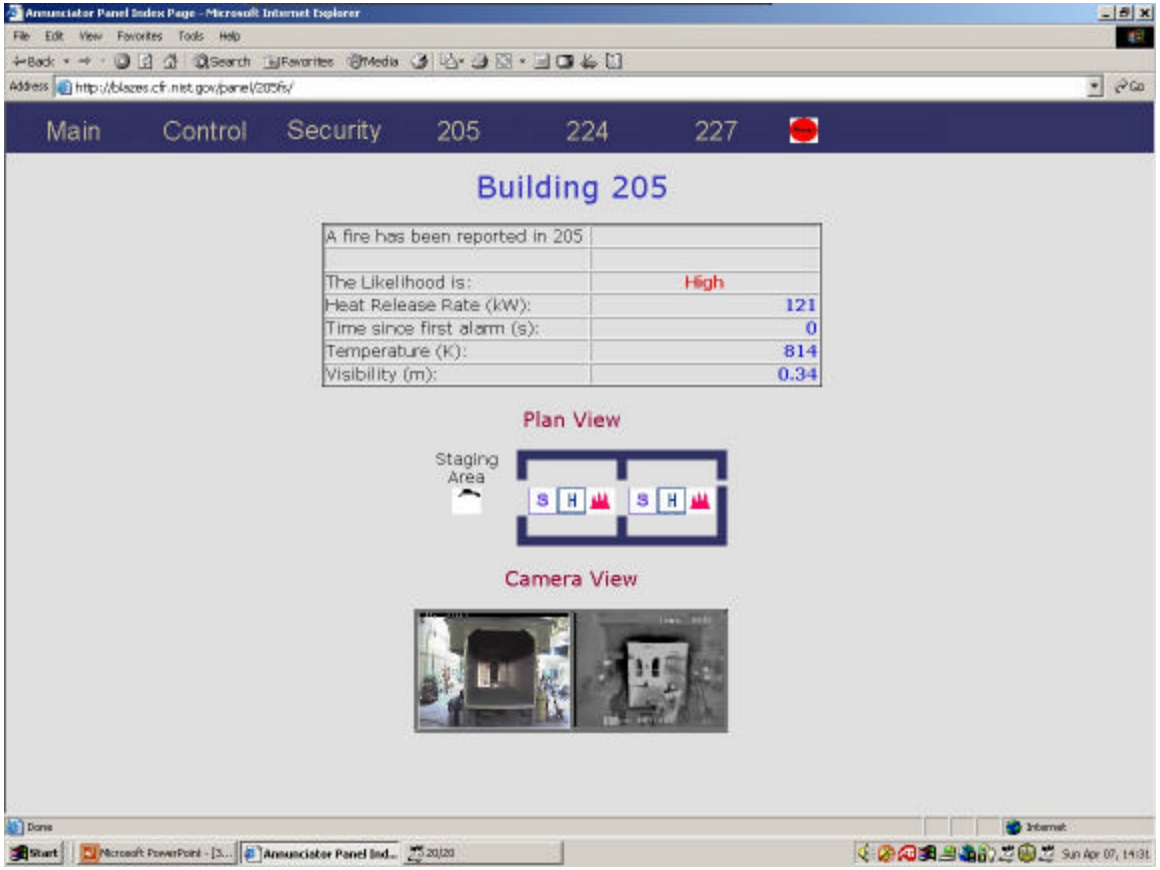


First Example Showing Implementation of Layers One and Three



Building 205
April 3, 2002

Second Example of Active Systems (205)



VIDEO

County Municipal Office Building
New Castle, Delaware

Wednesday, May 22, 2002

This is the Difficulty

Conclusions

- Fire service emergency response can be improved by more information from buildings alarm systems
- Standard systems allow interconnect
- A series of demonstrations is key to building understanding and developing ideas for better implementations.

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